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(72) CONRAD, Helmut Gerhard, CA
(72) PHILLIPS, Richard Stanley, CA
(72) CONRAD, Wayne Ernest, CA
(71) FANTOM TECHNOLOGIES INC., CA

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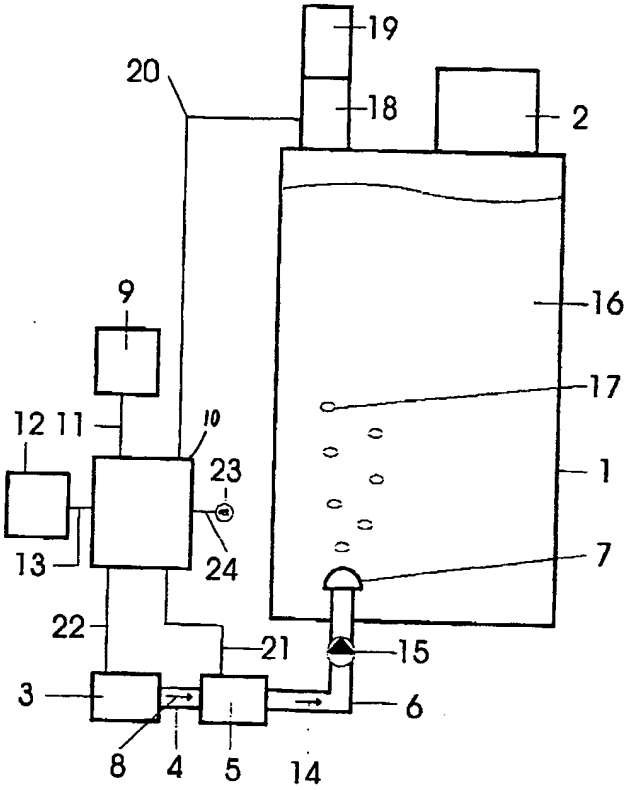
(54) **CONTACTEUR A MODULATION DE PRESSION POUR L'OZONISATION DE L'EAU**

(54) **PRESSURE SWING CONTACTOR FOR OZONE WATER TREATMENT**



(57) A method for treating a liquid comprising the steps of introducing a gas to treat the liquid into a sealed vessel; increasing the pressure in the vessel to promote the dissolution of the gas into the liquid; and either releasing the pressure when the pressure in the vessel reaches a predetermined level or monitoring the treatment of the liquid and releasing the pressure when the treatment of the liquid in the vessel reaches a predetermined level. An apparatus for use with this method is also disclosed.

Title: PRESSURE SWING CONTACTOR FOR OZONE WATER TREATMENT

FIELD OF THE INVENTION

This invention relates of an apparatus for treating a liquid such as water with a gas such as ozone. The apparatus may be used in the production of water fit for human consumption from water contaminated by microorganisms, chemicals, heavy metals and minerals. The gas may be present either by itself or in combination with one or more other gasses and/or a liquid. Further, the liquid with which the gas is reacted may be present by itself or may also have one or more liquids and/or one or more other gases associated therewith.

BACKGROUND OF THE INVENTION

The production of water fit for human consumption from water contaminated by microorganisms, chemicals, heavy metals and minerals is a requirement throughout the world. Many different proposals have been made for the purification of contaminated water.

The most popular system in widespread use for the purification of contaminated water is a pitcher wherein contaminated water is passed through a filter made of a combination of a porous media filter, activated carbon, and an ion exchange resin and into a clean water reservoir within the pitcher. This type of system will reduce the levels of chlorine, lead, and pesticides. However, there are several disadvantages associated with this device. The first disadvantage of this water purification system is that the structure of the filter provides a breeding ground for microorganisms thereby multiplying the dangers of microorganisms which may be present in very low numbers. Another disadvantage of such a water purification system is that the filter life is not measured and it is possible for the user to employ

the filter beyond its useful life. A further disadvantage of such a water purification system is that oils and fuels often present in water drawn from lakes and rivers are not readily removed and that said oils and fuels tend to coat the filters and damage their operational life and effectiveness. Some filtration based products now incorporate a means of measuring the water volume passing though the filter and an indicator as to when to change the filter. Other filters incorporate an iodine product to minimize the risk of microbiological hazards, however, these materials often impart undesirable tastes and many are potential carcinogens.

Another popular system in use for the purification of contaminated water is a system which employs an ultraviolet light for disinfection in series with a porous media and carbon filter. This type of system will reduce the levels of chlorine, lead, and pesticides and has some disinfection capability. However, there are several disadvantages associated with this device. The first disadvantage of this water purification system is that the ultraviolet light's disinfection efficacy is greatly diminished by turbidity or color in the water which can cause the filter to become contaminated by microorganisms which can readily live and breed therein thereby multiplying the danger from any microorganisms which may be present. Another disadvantage of such a water purification system is that the filter life is not measured and it is possible for the user to employ the filter beyond its useful life. A further disadvantage of such a water purification system is that oils and fuels often present in water drawn from lakes and rivers are not readily removed and that said oils and fuels tend to coat the filters and damage their operational life and effectiveness. Some filtration based products now incorporate a means of measuring the water volume passing though the filter and an indicator as to when to change the filter. Other filters incorporate an iodine product to minimize the risk of

microbiological hazards, however, these materials often impart undesirable tastes and many are potential carcinogens.

Clearly therefore, it is desirable that the design of a water purification system will employ a filtration stage prior to ozone, ozone for disinfection and oxidation, and a post ozone filtration stage to remove any residual ozone and products of ozonation from the water before consumption. It is also desirable that the design of a water purification system will employ a means of ensuring disinfection efficacy. It is also desirable that the design of a water purification system will employ a means of monitoring the filter usage and provide the user with an indication to change the filter.

BRIEF SUMMARY OF THE INVENTION

In accordance with the instant invention, there is provided a method for treating a liquid comprising the steps of:

(a) introducing a gas to treat the liquid into a sealed vessel;

(b) increasing the pressure in the vessel to promote the dissolution of the gas into the liquid; and,

(c) releasing the pressure when the pressure in the vessel reaches a predetermined level.

In accordance with another embodiment of the instant invention, there is provided a method for treating a liquid comprising the steps of:

(a) introducing a gas to treat the liquid into a sealed vessel;

(b) increasing the pressure in the vessel to promote the dissolution of the gas into the liquid; and,

(c) monitoring the treatment of the liquid and releasing the pressure when the treatment of the liquid in the

vessel reaches a predetermined level.

In one embodiment, the method also comprises the step of signalling a user that the treatment is complete.

In accordance with another embodiment of the instant invention, there is provided an apparatus for treating a liquid with a gas comprising:

(a) a vessel having a gas inlet port for providing a pressurized source of gas for treating the liquid, a liquid inlet port for introducing a liquid into the vessel and a gas outlet port;

(b) a disperser for introducing the gas into the liquid in the vessel; and,

(c) a pressure activated valve for releasing pressure from the vessel when the vessel reaches a predetermined pressure.

In one embodiment, the vessel is removable from the apparatus.

The apparatus may further comprise a check valve in flow communication with the gas inlet port to prevent fluid from flowing upstream to the source of gas for treating the liquid.

Preferably, the liquid is water and the gas to treat the water comprises ozone and the apparatus further comprises an ozone generator. In this embodiment, the apparatus may further comprise an oxygen concentrator.

In accordance with another embodiment of the instant invention, there is provided an apparatus for treating a liquid with a gas comprising:

(a) a vessel having a gas inlet port for providing a pressurized source of gas for treating the liquid, a liquid inlet port for introducing a liquid into the vessel and a gas outlet port;

(b) a disperser for introducing the gas into the liquid in the vessel; and,

(c) a sensor for monitoring the treatment of the liquid and signalling when the treatment reaches a predetermined level.

In one embodiment, the apparatus further comprises a pressure activated valve for releasing pressure from the vessel when the treatment reaches a predetermined level.

BRIEF DESCRIPTION OF THE DRAWINGS

A further, detailed description of the invention, briefly described above, will follow by reference to the following drawings of a preferred embodiment of the invention in which:

Figure 1 shows a schematic representation of the apparatus according to the instant invention; and,

Figure 2 shows a schematic representation of an alternate apparatus according to the instant invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 illustrates a means for efficiently dissolving ozone in water and subsequently causing microbubble formation to disinfect said water and oxidize pollutants present.

Water 16 is introduced into container 1 such as through a resealable cap 2 which may be affixed to container 1 such as by a screw thread of a bayonet mount, and the resealable cap is closed. The control circuit means of this device derives power from, for example, a batter 12 by means of wire 13. A user may then activate the unit by pushing start button 9 which sends a signal to the control circuit 10 through the wire 11.

The unit is provided with a source of oxygen. This may be the ambient air. Preferably, oxygen enriched air is used.

Accordingly, the unit may be connected to a source of oxygen enriched air or, preferably, the unit may include an oxygen concentrator, such as those which utilize pressure swing adsorption and are known in the art. Pressurized air may be provided to an oxygen concentrator such as by a motor driven fan (not shown).

When start button 9 is pushed, the control circuit provides power to the oxygen rich gas source 3 and to the ozone generator 5 through wires 21 and 22.

The pressurized gas containing oxygen 8 then flows from the oxygen rich gas source 3 through tube 4 and into the ozone generator 5 where at least a fraction of the oxygen present is converted to ozone. This ozone oxygen mixture 14 then flows through the pipe 6, through the one way check valve 15 and into the water 16 through the sparger 7 which serves to disperse the gas into fine bubbles 17. It will be appreciated that the unit may be connected to a source of pressurized gas containing ozone.

As there is no vent from container 1, the pressure in the container builds thereby increasing the amount of gas which will dissolve into the water 16. When the pressure within the chamber 1 reaches a given pressure (which may be predetermined), the pressure relief valve and pressure switch 18 causes the chamber to be vented to the atmosphere through, for example, an ozone off gas destructor 19 and a signal may be sent to the controller means 10 through wire 20 indicating that a cycle has been completed.

The completion of one or more cycles is a means of controlling the endpoint of the water treatment process. When the endpoint of the process is reached, the controller 10 may turn off the power to the oxygen rich gas source 3 and to the ozone generator 5 through wires 21 and 22 and signal the user that the process is complete by providing power to the green light 23 by means of wire 24.

An alternate embodiment is shown in Figure 2. Water 16 is introduced into container 1 through a resealable cap 2 mounted affixed to the container 1, and the resealable cap is closed. The control circuit of this device derives power from, eg., a battery 12 by means of wire 13. The consumer then activates, eg., start button 9 which sends a signal to the control circuit means 10 through the wire 11. This causes the control circuit means to provide power to the oxygen rich gas source 3 and to the ozone generator 5 through wires 21 and 22. The pressurized gas containing oxygen 8 then flows from the oxygen rich gas source 3 through tube 4 and into the ozone generator 5 where at least a fraction of the oxygen present is converted to ozone. This ozone oxygen mixture 14 then flows through the pipe 6, through the one way check valve 15 and into the water 16 through the sparger 7 which serves to disperse the gas into fine bubbles 17. As there is no vent from container 1 the pressure in the container builds thereby increasing the amount of gas which will dissolve into the water 16.

When the pressure within the chamber 1 reaches a given pressure, the pressure relief valve and pressure switch 18 cause the chamber to be vented to the atmosphere through an ozone off gas destructor 19 and a signal to be sent to the controller 10 through wire 20 indicating that a cycle has been completed. An ORP sensor 26 monitors the ORP level and transmits it to the controller 10 through a wire 25. The controller monitors the redox level and the time for which a redox is maintained to determine the endpoint of the water treatment process.

If a suitable redox level is maintained for a prescribed time, the desired endpoint is reached and the controller means 10 signals that the process is complete to the user by providing power to the green light 23 by means of wire 24. If a suitable redox level is not achieved and maintained for a prescribed time, and a preset

time elapses, the endpoint of treatment is reached and the water is not suitable for consumption hence the controller 10 may signal that the process is complete but the water is unsuitable for use by providing power to the red light 27 by means of wire 28.

WE CLAIM

1. A method for treating a liquid comprising the steps of:
(a) introducing a gas to treat the liquid into a sealed vessel;
(b) increasing the pressure in the vessel to promote the dissolution of the gas into the liquid; and,
(c) releasing the pressure when the pressure in the vessel reaches a predetermined level.

2. The method as claimed in claim 1 further comprising the step of signalling a user that the treatment is complete.

3. A method for treating a liquid comprising the steps of:
(a) introducing a gas to treat the liquid into a sealed vessel;
(b) increasing the pressure in the vessel to promote the dissolution of the gas into the liquid; and,
(c) monitoring the treatment of the liquid and releasing the pressure when the treatment of the liquid in the vessel reaches a predetermined level.

4. The method as claimed in claim 4 further comprising the step of signalling a user that the treatment is complete.

5. An apparatus for treating a liquid with a gas comprising:
(a) a vessel having a gas inlet port for providing a pressurized source of gas for treating the liquid, a liquid inlet port for introducing a liquid into the vessel and a gas outlet port;

(b) a disperser for introducing the gas into the liquid in the vessel; and,

(c) a pressure activated valve for releasing pressure from the vessel when the vessel reaches a predetermined pressure.

6. The apparatus as claimed in claim 5 wherein the vessel is removable from the apparatus.

7. The apparatus as claimed in claim 5 wherein the apparatus further comprises a check valve in flow communication with the gas inlet port to prevent fluid from flowing upstream to the source of gas for treating the liquid.

8. The apparatus as claimed in claim 1 wherein the liquid is water and the gas to treat the water comprises ozone and the apparatus further comprises an ozone generator.

9. The apparatus as claimed in claim 8 further comprising an oxygen concentrator.

10. An apparatus for treating a liquid with a gas comprising:

(a) a vessel having a gas inlet port for providing a pressurized source of gas for treating the liquid, a liquid inlet port for introducing a liquid into the vessel and a gas outlet port;

(b) a disperser for introducing the gas into the liquid in the vessel; and,

(c) a sensor for monitoring the treatment of the liquid and signalling when the treatment reaches a

predetermined level.

11. The apparatus as claimed in claim 10 further comprising a pressure activated valve for releasing pressure from the vessel when the treatment reaches a predetermined level.

12. The apparatus as claimed in claim 10 wherein the vessel is removable from the apparatus.

13. The apparatus as claimed in claim 10 wherein the apparatus further comprises a check valve in flow communication with the gas inlet port to prevent fluid from flowing upstream to the source of gas for treating the liquid.

14. The apparatus as claimed in claim 10 wherein the liquid is water and the gas to treat the water comprises ozone and the apparatus further comprises an ozone generator.

15. The apparatus as claimed in claim 14 further comprising an oxygen concentrator.

ABSTRACT OF THE DISCLOSURE

A method for treating a liquid comprising the steps of introducing a gas to treat the liquid into a sealed vessel; increasing the pressure in the vessel to promote the dissolution of the gas into the liquid; and either releasing the pressure when the pressure in the vessel reaches a predetermined level or monitoring the treatment of the liquid and releasing the pressure when the treatment of the liquid in the vessel reaches a predetermined level. An apparatus for use with this method is also disclosed.

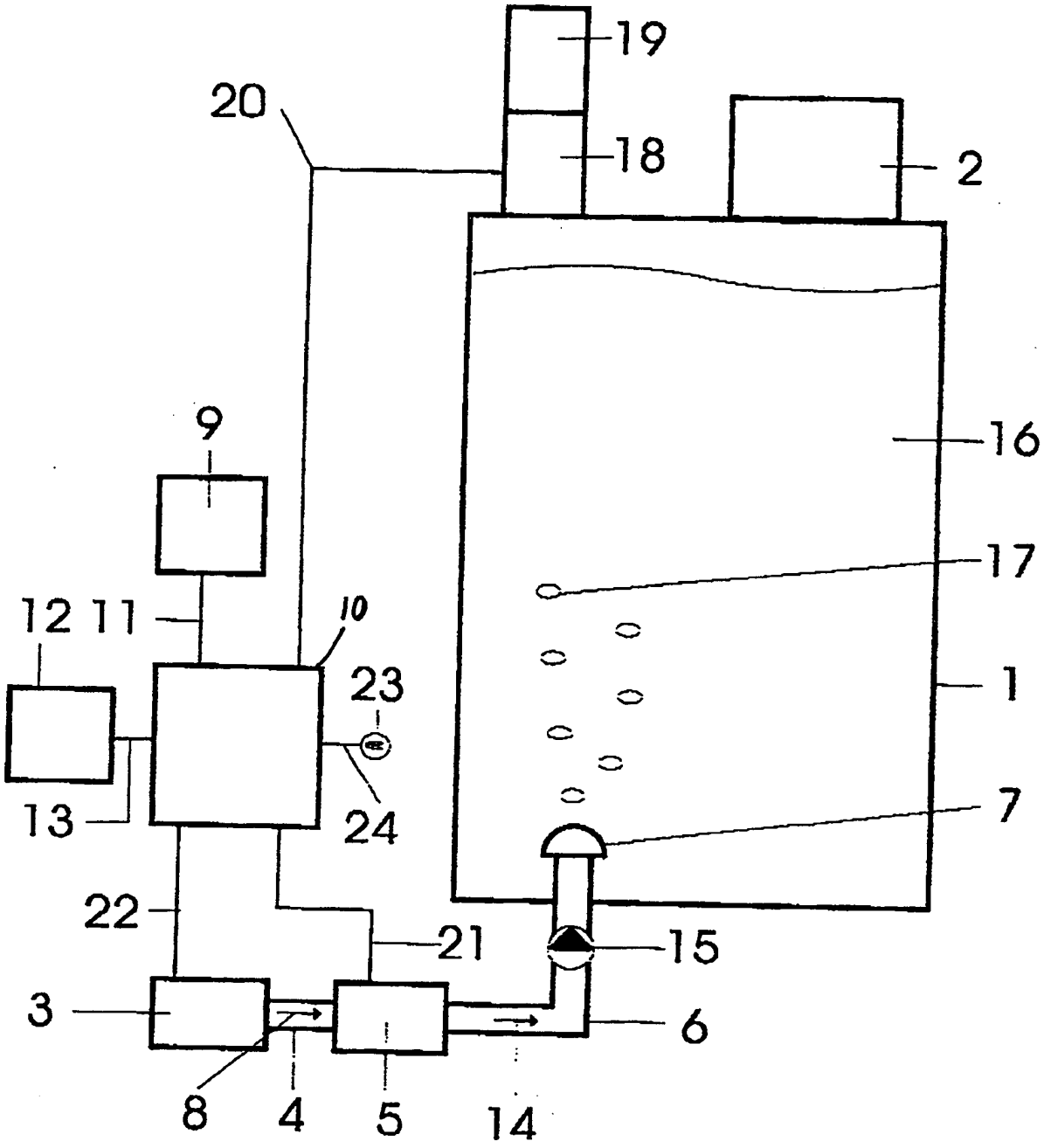


Figure 1

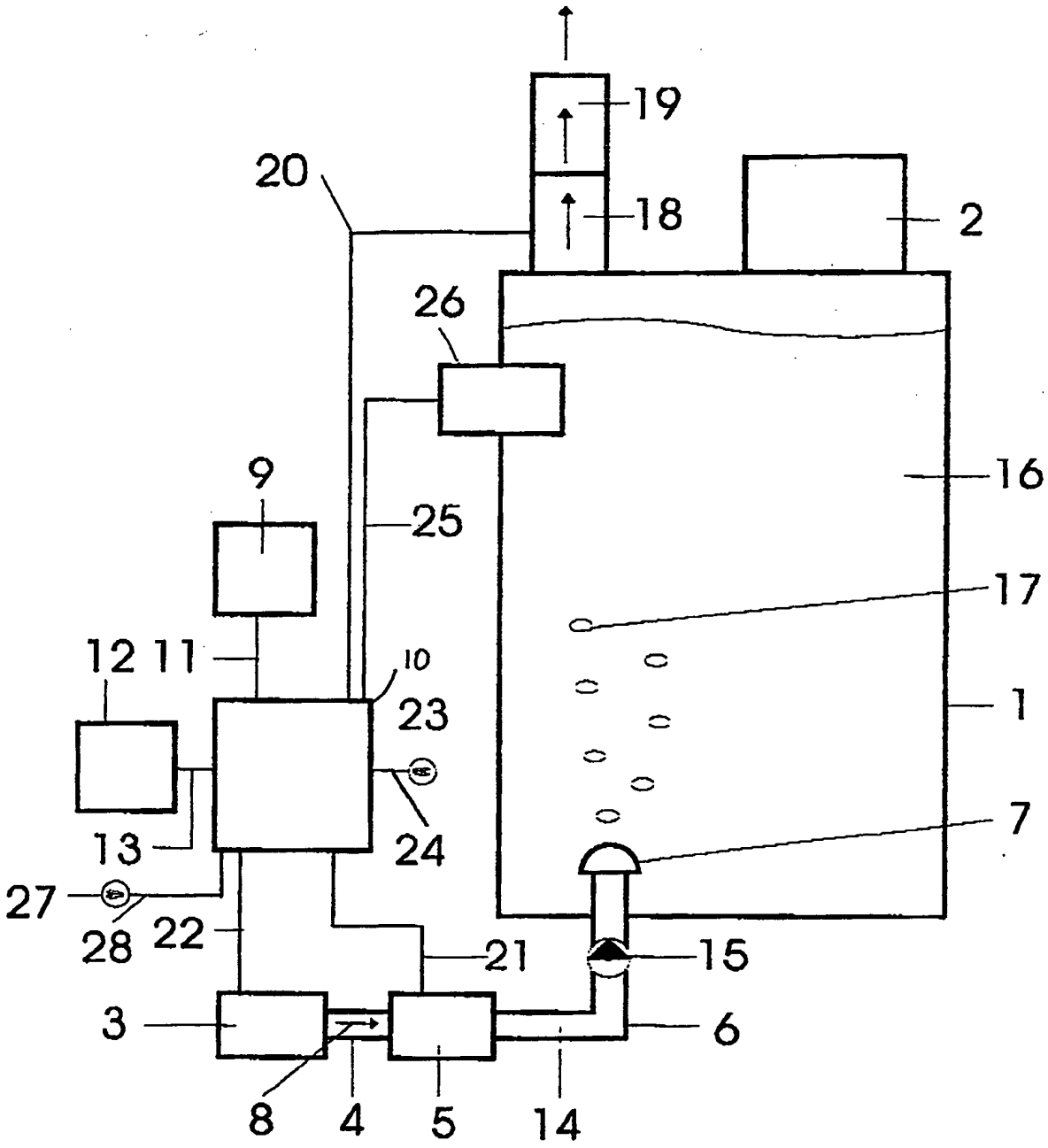


Figure 2